FORM PTO-1390
(REV 12-29-99)

U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: MOT-D2191

US APPLICATION NO. (If known, see 37 CFR 1.5): 09/787602

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/US99/21666	20 September 1999	21 September 1998

TITLE OF INVENTION: METHOD AND APPARATUS FOR SHUFFLING AND DESHUFFLING VIDEO SIGNALS

APPLICANT(S) FOR DO/EO/US: Charles P. Kelly and Douglas N. Nelson

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [ ] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [ ] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [x] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [x] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [x] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [x] Other items or information:
    International Publication with Search Report;
    International Preliminary Examination Report;
    Written Opinion; and
    Reply to Written Opinion

JC10 Rec'd PCT/PTO 21 MAR 2001

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/787602	PCT/US99/21666	MOT-D2191

	CALCULATIONS	PTO USE ONLY
17. ☐ The following fees are submitted:		
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 130.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	11 - 20 =	0	X **$18.00**	$	
Independent claims	3 - 3 =	0	X **$80.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$260.00**	$ 260.00	
TOTAL OF ABOVE CALCULATIONS =				$ 1250.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also by filed (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$ 1250.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$ 1250.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 1250.00	
				Amount to be refunded:	$
				charged:	$

a. ☒ A check in the amount of $ 1250.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 22-0493. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

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SIGNATURE

Gerald B. Halt, Jr., Esquire
NAME

37,633
REGISTRATION NUMBER

4/PRTS

METHOD AND APPARATUS FOR SHUFFLING AND DESHUFFLING VIDEO SIGNALS

BACKGROUND

This invention is related to encoding and decoding of video information, and more particularly to a method and apparatus for securing the transmission of video signals so that only authorized subscribers can view transmitted video information.

Systems have been developed for scrambling television signals to secure transmission of video information. An example of a scrambling technique involves "block shuffling" wherein a television field consisting of video lines is divided into several blocks or groups of video lines. The video lines within each block are then randomly shuffled or scrambled so that the original line sequence is changed to a new scrambled line sequence within each block. The scrambled video signals are then transmitted to a receiver along with data relating to a code corresponding to the order of the randomly shuffled lines in each block. A receiver having a decoder is utilized at a subscriber location to return the lines within each block to their original sequence so that a video display of each block recreates the original field.

U.S. Patent No. 5,321,748 discloses a method and apparatus for scrambling video signals utilizing such a block shuffling technique. A block of video lines is divided into top and bottom sub block portions. The top and bottom sub block portions are switched and within each sub block portion, the video lines are randomly shuffled. This is said to improve masking of the original video information by increasing the expected value of line displacement.

U.S. Patent No. 4,405,942 discloses another method and system for secure transmission and reception of a video signal wherein parts of the video signal are delayed in relation to each other to form an encoded video signal. The encoder utilizes two field memories and a flip flop such that a first field is loaded into one of the field memories and then before the next field of video information arrives, the flip flop changes state for loading the next field of video information into the second field memory.

Several problems exist in that signal distortion effects occur during transmission. Some of these effects include field tilt or hum caused by cable amplifiers, nonlinear transmitters, or receiver imperfections. These distortion affects may change the luminance of lines in a field. Luminance is typically distorted across the field such that minimal distortion occurs at the top of the field and maximum distortion occurs at the bottom of the field. For example, line 1 may experience a low level of distortion while line 500 experiences a high level of distortion. Since the change in distortion is gradual from the top of the field to the bottom of the field, it is usually not noticeable when a television signal is transmitted and viewed at a subscriber's television. When the lines are shuffled, transmitted, and then deshuffled at a subscriber location, sharp contrasts in luminance between adjacent deshuffled lines may be visible on the video display. This occurs because the shuffled field is transmitted and the gradual distortion effect described above is applied during the transmission. During deshuffling, a line which was transmitted at position 1 with a low level of distortion may be moved next to a line which was transmitted at position

500 having a high level of distortion creating an undesirable effect which is visible in the television picture received at the subscriber location. This problem is exaggerated by increasing the average expected line displacement during the shuffling process. Therefore, the maximum average line displacement will be limited by the trahsmission network causing the distortion. For example, a network having high distortion can accommodate a smaller average line displacement than a network having lower distortion. Since increasing average line displacement improves masking, it is therefore desirable to transmit scrambled signals having the maximum average line displacement which network distortion permits.

Another problem exists in that systems for encoding or decoding the video signals typically utilize a plurality of memories for processing. This increases the number of components necessary to implement such a system and also introduces unwanted delay in signal processing.

SUMMARY

It is therefore an object of the present invention to provide a method and apparatus for scrambling and descrambling video signals utilizing a shuffling technique which is adaptable to a given network for maximizing masking of the video signal while minimizing undesirable effects of network distortion.

It is a further object of the invention to implement such a system in order to minimize the number of memory components and delay in signal processing.

These and other objects have been achieved by providing a method for video line shuffling wherein a picture field containing a plurality of lines is first applied to a shuffling function having a first block size parameter and a first increment parameter. Next, the shuffled lines are applied to a second shuffling function having a second block size parameter and a second increment parameter. Memory requirements are reduced in the deshuffling method by utilizing a single memory and writing to locations in that memory in a step immediately following a read from the respective locations. Where the memory device utilized is a DRAM, a method is presented for refreshing rows and columns of the DRAM without the need for strobing.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block representation of the shuffling and deshuffling process.

Figure 2 is a diagram of a recursive function for shuffling or deshuffling lines of a video field.

Figure 3 is a graph showing input line number versus output line number for a first shuffling method.

Figure 4 is a graph showing input line number versus output line number for a second shuffling method.

Figure 5 is a diagram of a video shuffling method having reduced memory requirements.

Figure 6 is a table showing memory write locations for a series of video line samples.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The video line shuffling method will first be described generally with reference to **Figure 1.** A shuffler first applies a permutation **P** to an original picture **10**. The permutation **P** rearranges the line sequence of the original picture **10** to form a shuffled picture **20**. The shuffled picture **20** is considered to be masked or secure because if viewed on a monitor or television, the original picture **10** is unintelligible.

The shuffled picture **20** is transmitted over a network to a set top terminal having a deshuffler for reconstructing the original picture **10**. The deshuffler serves to apply an inverse permutation $\mathbf{P^{-1}}$ to the shuffled picture **20** to create a reconstructed picture **10'**. The deshuffler having the inverse permutation $\mathbf{P^{-1}}$ rearranges the shuffled lines into their original positions to reconstruct the original picture.

The shuffling method will now be described in greater detail with reference to **Figure 2**. The permutation **P** is defined by a series of shuffling functions g(x). Each shuffling function g(x) is defined by a pair of shuffle parameters (B, I) where the B values correspond to a block size and the I values correspond to an increment within the block. Therefore, if the line number, x is known, each shuffling function can be described by:

g(x,B,I)

To complete the permutation, a series of shuffling functions may be applied to the original picture **10**. **Figure 2**, for example, shows the application of three such shuffling functions resulting in the permutation defined by:

g(g(g(x,B1,I1),B2,I2),B3,I3)

where x is the original line number of a given line in a field, B**n** is a parameter defining the block size for a respective shuffling function **n**, and I**n** is a parameter defining an increment within the blocks for the respective shuffling function **n**. Following a line, for example line 1, through the permutation, it can be seen that line 1 enters the first shuffling function and exits at position 4. It then exits the second shuffling function at position 9 and exits the third shuffling function at position 12. The inverse permutation $\mathbf{P}^{-1}$ is represented by a reverse path traveling from the right to left side of **Figure 2**. It should be understood that B and I values can be selected to achieve a number of different permutations **P** and inverse permutations $\mathbf{P}^{-1}$. By selecting B and I values the permutation **P** can be designed to limit line displacement. For example, in **Figure 2**, B1, B2 and B3are selected so that the resultant blocks have coincident boundaries **H1, H2, H3** at the center of each shuffling function. The result is that no line will cross the center of the permutation **P** thus limiting maximum line displacement to within on half of the picture **10**.

Referring now to **Figures 3** and **4**, results data will be described for two different permutations applied by the shuffler of **Figure 1**. It should be understood that these permutations are shown to illustrate how masking is limited by system

distortion. Also, these permutations are different from the permutation presented in **Figure 2**. **Figure 3** shows a graphical representation of input line versus output line numbers for a first selected permutation **P**. The resultant pattern indicates that each line of the original picture **10** is moved only a small amount in the shuffle picture **20**. This permutation is desirable for systems that have high levels of distortion introduced during transmission. The reconstructed picture **10'** will exhibit only minor distortion upon reconstruction. This permutation, however, provides a low level of masking since the lines are shuffled in a pattern along a relatively small displacement.

Figure 4 shows a graphical representation of input line versus output line number for a second permutation **P**. This permutation, exhibits a high level of line displacement and is suitable for systems containing less distortion. It can be appreciated that this permutation provides a higher degree of masking since lines are displaced more than the those of **Figure 3**.

Video line shuffling/deshuffling methods require the use of memory, typically random access memory (RAM), for temporarily storing and reading lines during permutation. Since reducing the number of components in such a system often reduces the cost, it is desirable to minimize the amount of memory necessary for performing the shuffling and deshuffling method. Additionally, memory typically represents a large percentage of the cost associated with a finished terminal containing the deshuffler. As described in the background section, known techniques utilize a pair of memories, one memory typically is written to in a cycle

while the other memory is typically read from in order to perform the deshuffling. **Figure 5** shows a method of deshuffling utilizing an exemplary single four location memory. It should be understood that while a four location memory is utilized in this example in order to simplify the explanation, smaller or larger memories can be utilized with this method. Also, for ease of explanation, a simplified permutation **M** and inverse permutation $\mathbf{M}^{-1}$ will be described. Those reasonably skilled in the art will appreciate that a more complex permutation such as that shown in **Figure 2** could be applied to this method. The memory which will be described is located within a decoder which is typically part of a set top terminal at a subscriber location. The shuffler is typically positioned at the head end of a video transmission system.

Beginning at the upper left corner of **Figure 5**, in the first step, an original line sequence of 1, 2, 3, 4 has been stored in the memory. A deshuffler reads the memory in order such that 1 is read from the first position. Next, the shuffler sends a permutation 2, 3, 1, 4 which is stored in consecutive memory locations as shown in steps 2-5. Also during this second step, the deshuffler continues to read from the memory in order such that the second, third and fourth locations are read. During the fifth step, the deshuffler does not read from the memory. This is because between steps 5 and 6, the Verticle Blanking Interval (VBI) occurs. This is shown by way of example to illustrate how an interval is provided between steps for the VBI. Those skilled in the art will appreciate that while the VBI is shown between steps 5 and 6 and again between steps 10 and 1, the method can be adapted to provide this interval between different steps according to timing requirements of any

given system. In step 6, the deshuffler reads from memory locations utilizing the inverse permutation 3, 1, 2, 4. In step 7 the shuffler begins consecutively storing according to the inverse permutation 3, 1, 2, 4. It should be noticed that in each step where the shuffler stores a value into a memory location, the deshuffler in the previous step has read from that same location. Therefore, each memory location is utilized as soon as it is made available by having been read from It should be noted that the shuffler sends the inverse permutation M^{-1} based upon the location number of the most recently read data in steps 6-10. For example in step 6, a 1 is read from location 3, therefore in step 7, the shuffler sends a 3 corresponding to the location number previously read. In step 7 the deshuffler reads 2 from location 1, therefore the shuffler sends a 1 corresponding to the location number previously read. Based upon this logic, the inverse permutation 3, 1, 2, 4 is generated.

Another method of reducing cost of the finished terminal is to select lower cost memory components. For example, DRAM may be suitable from economic and design requirements perspectives. The use of DRAM as a memory device for the deshuffler and a novel write method will now be described in greater detail with reference to **Figure 6**. First it should be understood that each line of video is digitally sampled for storage in the memory. In this example, 909 samples are taken per line. It should also be understood that the number of samples may be selected according to system design requirements. DRAM is typically arranged to have locations in rows and columns. In order to refresh a row of DRAM, it is necessary to either write to or strobe any column in that row. Likewise, in order to refresh any

column, it is necessary to write to or strobe any row along that column. It is necessary to refresh all rows and columns at a minimum time interval prescribed by the DRAM. In this case, the refresh rate for the selected DRAM is 8 ms. Since DRAM is required to have its columns and rows refreshed at the refresh rate, they are typically strobed to maintain the data stored in locations in the associated rows and columns. A problem is presented in that strobing requires added bandwidth to send the strobe signals. The following method eliminates the need for the strobe signals and therefore reduces bandwidth requirements. Write locations are selected in such a way that rows and columns are written to within a minimum time interval prescribed by the refresh rate to avoid losing data stored therein and to avoid the need to strobing the rows or columns.

Referring now to **Figure 6**, the storage of 909 samples representing video line 0 will be described.. The first 127 samples are written into row 0. Along row 0 of the DRAM, the samples are written into columns 0 through 127. The samples 128-255 are next written into row 64, columns 128-225. This pattern continues until sample 512. The particular DRAM selected for this application utilizes a nine bit column address having a maximum value of 511. Continuing along video line 0, samples 512-639 are written into row 256, columns 0-127. It is therefore evident that the column numbers wrap back to 0 after reaching the maximum value of 511. Continuing along video line 0, samples 640-767 are written into row 320, columns 128-255. Samples are written at an approximate rate of 14 million samples per second. This allows 128 lines of 909 samples to be written into DRAM every 8 ms.

With each line being written according to **Figure 6**, this method serves to refresh each column and each row within the given time interval necessary for the DRAM.

An advantage of the present invention is that the shuffling method provides a controlled amount of maximum line displacement which is adjustable depending upon the distortion present in a given system. This provides for a maximum masking level within the confines of system distortion.

An additional advantage is that one memory may be utilized to deshuffle a shuffled picture.

An additional advantage is that where DRAM is utilized for the memory, the need for strobing or refreshing the memory is eliminated.

It should be understood that while this invention is presented here in the form of the embodiments shown, the scope of the invention is intended to be limited only by the following claims.

What is claimed is:

1. A method for shuffling a plurality of video lines; the plurality of video lines being grouped into a plurality of blocks, whereby the video lines are shuffled within each said block, comprising the steps of:

applying a first shuffling function to a plurality of lines within a first block to generate a first plurality of permutated lines, the first shuffling function using a first block size parameter B_1 and a first increment parameterI_1; and

applying a second shuffling function to said first plurality of permutated lines within a second block to generate a second plurality of permutated lines, the second shuffling function using a second block size parameter B_2 and a second increment parameter I_2.

2. The video line shuffling method of claim 1 wherein line displacement within said first and second blocks is limited by the respective increment parameter I_1, I_2.

3. The video line shuffling method of claim 1 further comprising the step of applying a third shuffling function to said second plurality of permutated lines, the third shuffling function having a third block size parameter B_3 and a third increment parameter I_3.

4. The video line shuffling method of claim 3 further comprising the step of applying a series of shuffling functions to a series of pluralities of permutated lines, the series containing at least one shuffling function having a respective block size parameter B and a respective increment parameter I.

5. The video line shuffling method of any one of claims 1 to 4 wherein the block size parameter of one of the shuffling functions defines a block having at least one boundary coincident with a boundary of a block of another shuffling function.

6. A video line shuffling method utilizing a shuffler at a first location and a deshuffler having a memory at a second location, the method comprising the steps of:

sending a first series of data shuffled according to a first permutation from the shuffler to the deshuffler;

characterized in that:

the first series of data is sequentially written into the memory such that data is written into a memory location immediately after that memory location has been read,

a second series of data is sent according to an inverse of the first permutation from the shuffler to the deshuffler; and

memory locations defined by the data are written to in the inverse permutation such that data is written into a memory location immediately after that memory location has been read.

7. A method of writing data into a memory having C columns and R rows defining a plurality of memory locations, the method comprising the steps of:

dividing the data into lines wherein each line contains a first length of data;

characterized in that:

said lines are divided into subsets each having a second length being smaller than the first length; and

each subset is written into a selected row and column range of the memory such that each time a subset is written, the selected row is incremented by a value I.

8. The method of claim 7 wherein I is selected so that each row has data written therein within a minimum selected time interval.

* * *

ABSTRACT

This invention teaches a video line shuffling method wherein video line displacement is variable and controlled depending upon the distortion in a given system. A series of permutations is applied to the original picture such that lines are shuffled in a controlled manner to achieve line displacement within a desired range. Memory requirements are minimized by utilizing a method whereby a single memory has data written into locations which were read from in a previous step. Where DRAM is utilized for the memory, a write method is employed to eliminate the need for strobing the rows and columns DRAM.

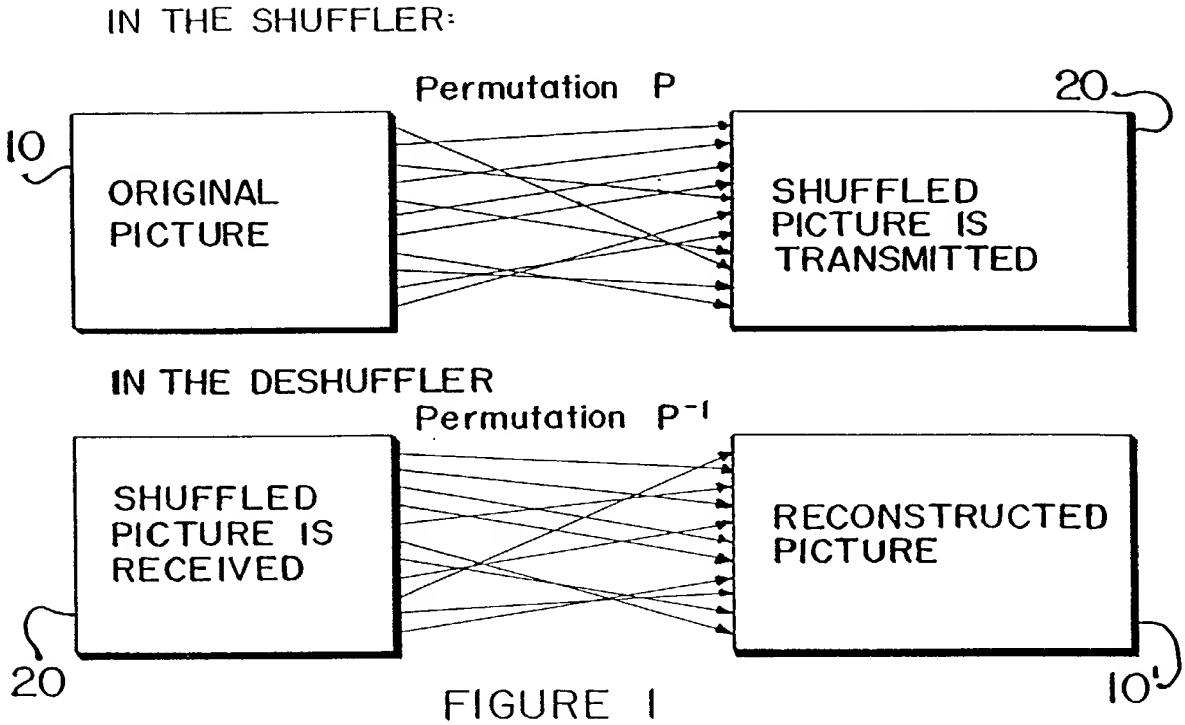
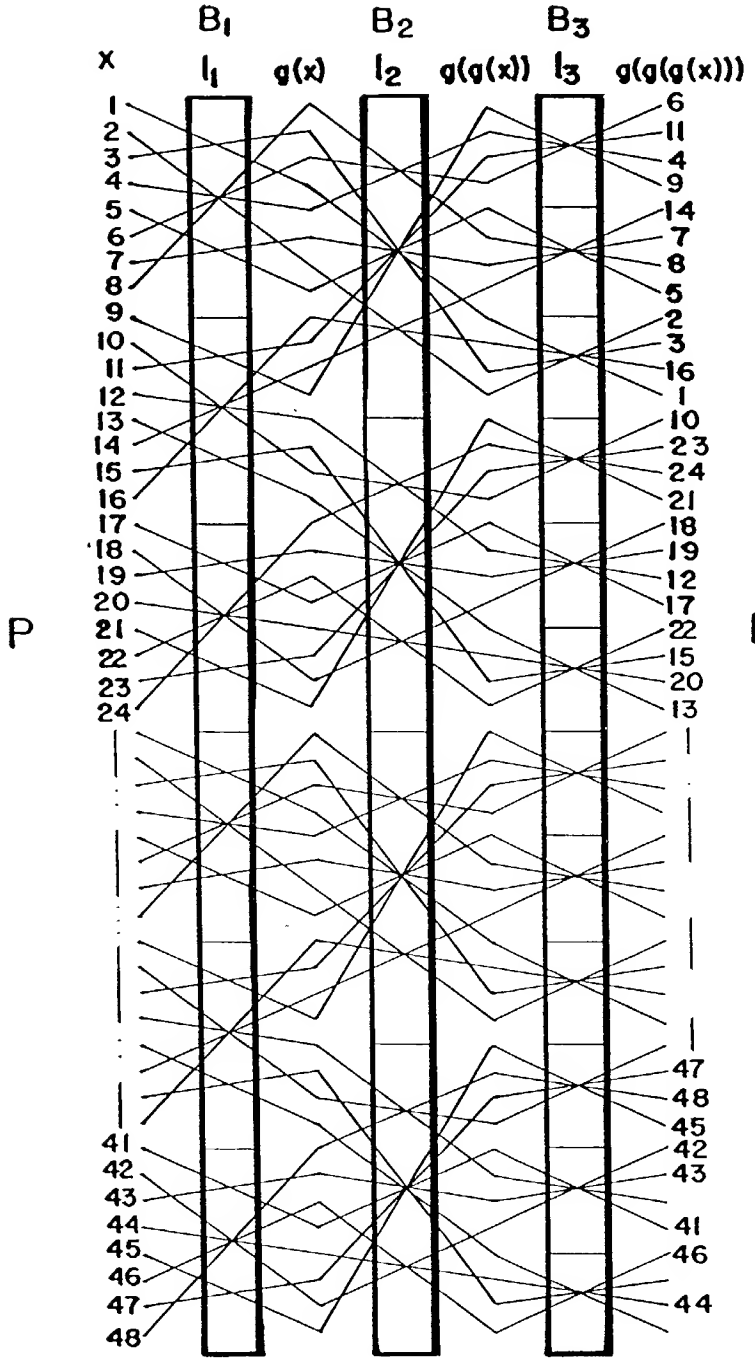

IN THE SHUFFLER:
Permutation P
10
20
ORIGINAL PICTURE
SHUFFLED PICTURE IS TRANSMITTED
IN THE DESHUFFLER
Permutation P^{-1}
SHUFFLED PICTURE IS RECEIVED
RECONSTRUCTED PICTURE
20
10'

FIGURE 1



$g(g(g(x,B_1,I_1),B_2I_2),B_3B_3)$

FIGURE 2

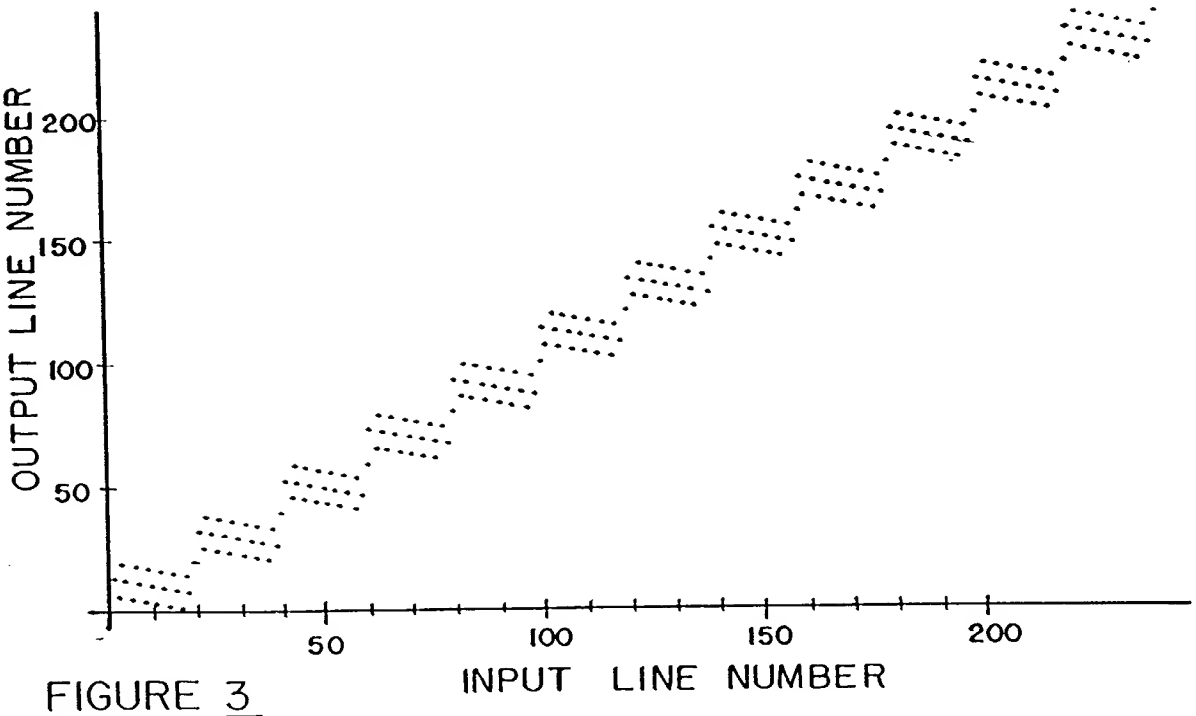


FIGURE 3

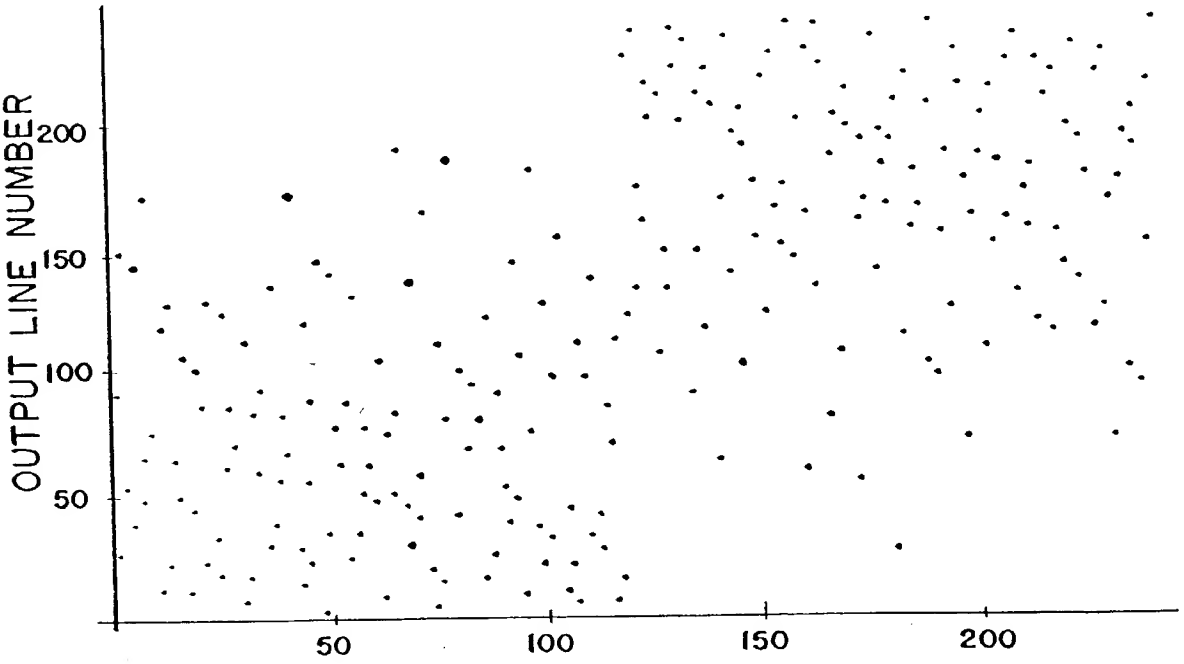


FIGURE 4

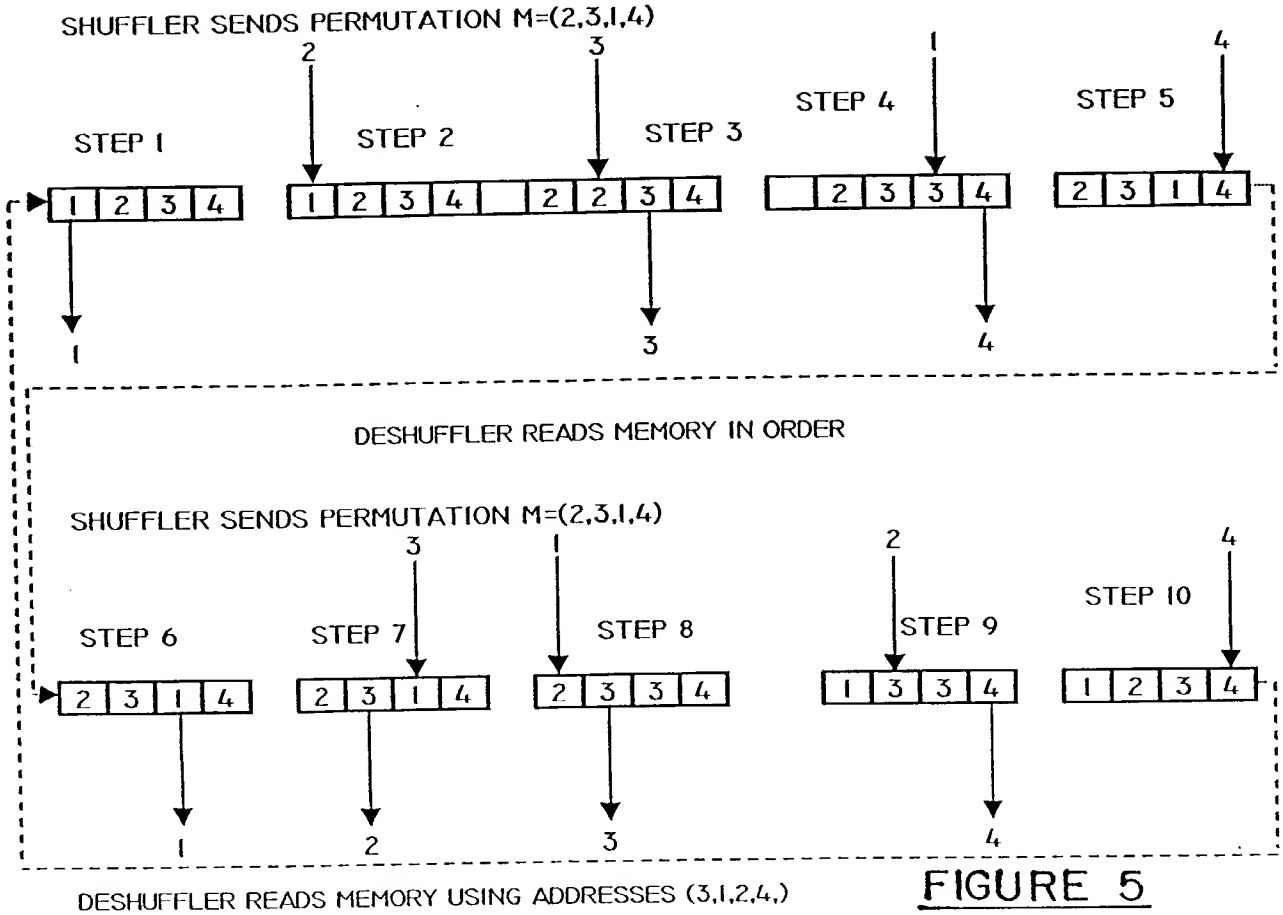


FIGURE 5

VIDEO LINE	ROW DURING SAMPLES							
	0-127	128-255	256-383	384-511	512-639	640-767	768-895	896-908
0	0	64	128	192	256	320	384	448
1	1	65	129	193	257	321	385	449
2	2	66	130	194	258	322	386	450
3	3	67	131	195	259	323	387	451
4	4	68	132	196	260	324	388	452
...	...	...	...	...	...	...	...	...
63	63	127	191	255	319	383	447	511
64	64	128	192	256	320	384	448	0
65	65	129	193	257	321	385	449	1
66	66	130	194	258	322	386	450	2
67	67	131	195	259	323	387	451	3
...	...	...	...	...	...	...	...	...
N	N	(N+64) %512	(N+128) %512	(N+192) %512	(N+256) %512	(N+320) %512	(N+384) %512	(N+448) %512

FIGURE 6

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PTO/SB/01 (12-97)
Approved for use through 9/30/00. OMB 0651-0032
Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	MOT-D2191
First Named Inventor	Kelly et al.
COMPLETE IF KNOWN	
Application Number	09/787,602
Filing Date	Not Yet Known
Group Art Unit	Not Yet Known
Examiner Name	Not Yet Known

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR SHUFFLING AND DESHUFFLING VIDEO SIGNALS

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) 09/20/1999 as United States Application Number or PCT International Application Number PCT/US99/21666 and was amended on (MM/DD/YYYY) _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*
PCT/US99/21666	09/20/1999	

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As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith ☒ Customer Number 24375 → *Place Customer Number Bar Code Label here*

OR

☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
Namely, the Attorneys of Volpe and Koenig, P.C			

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto

Direct all correspondence to: ☒ Customer Number or Bar Code Label 24375 *OR* ☐ Correspondence address below

Name	VOLPE AND KOENIG, P.C. DEPT MOT				
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Country		Telephone		Fax	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

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Charles P.	Kelly

Inventor's Signature						Date	
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☒ Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 1 of 1

2-00

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor		
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Mailing Address			
Mailing Address			
City	**State**	**ZIP**	**Country**